

Amendments to Specification

On page 1, please amend paragraphs 2, 3 and 4 to read as follows:

A humidity exchanger element dehumidifies gas by sorption mechanism a ~~reaction between a base and silicate aerogel~~of the desiccants such as aluminum oxide-silicate or titanium silicate / titanium-aluminum silicate.

According to US Pat. No. 5, 505, 769, the elements can be included in a sheet composed of inorganic fiber, or can be included in a device formed by the sheet.

However, the conventional humidity exchanger element ~~needs-necessitates~~regeneration at excessively elevated~~increased regeneration—~~temperatures (approximately 90~150°C). In addition, the element has demerits that a A sorption capacity thereof of the element is limited and that it causes a large amount of pressure loss of supply air for being dehumidified. ~~has high pressure loss, and moisture of content of supply air for being dehumidified is limited.~~ Also, a sorption capacity of the humidity exchanger element is decreased over time, that is, the element is greatly influenced by aging.

On page 2, please amend paragraphs 1, 2 and 3 to read as follows:

~~However, the lithium chloride is volatile by air flow contacted with the dehumidifying element, and as a result, the dehumidifying characteristics of the element are deteriorated while it is used.~~

———~~Also, the~~The humidity exchanger element containing lithium chloride can

not be used in highly humid environment. This is of the air because the lithium chloride tends to liquefy after absorbing the vapor moisture in the air especially in a highly humid condition.-

That is, when a solid lithium chloride is dissolved-changed into a liquid lithium chloride in a tropical climate or subtropical climate and the cellulose, the carrier thereof, comes to be unable to absorb and maintain the liquid lithium chloride due to its a-limited- sorption capacity-of the element, then so that the excessive liquid lithium chloride is dripping away from the element-can not be used. The base is discharged by steam and cellulose does not sufficiently absorb water due to its limited capacity, so that-resulting in a reduced content of the lithium chloride in the element the dehumidifying element becomes wet.

On page 2, please amend paragraphs 4 and 5 to read as follows:

Therefore, an object of the present invention is to provide a desiccant and a dehumidifying element which shows high humidity absorbing capacity without the aging influence maintains hygroscopic characteristics regardless of aging, and high humidity absorbing rate while needing-necessitating a small amount of energy for regeneration and a methods for fabricating the same. To achieve these and other objects and advantages and in accordance with the purpose of the present invention, as embodied and broadly described herein, there is provided a desiccantdehumidifying element which has an improved sorption capacity prepared by the ionic modificationincludes of -a super absorbing polymer (SAP) through contacting it with a salt solution, and a hygroscopic base.

There is also provided two a methods for fabricating a dehumidifying element. The one method for fabricating a dehumidifying element, which consists of a desiccant itself, comprises ~~comprising~~: a step of selecting a salt solution; a step of drying a super absorbing polymer (SAP), a step of contacting the dried SAP with the salt solution; and a step of drying a hydrogel generated by the contact between the SAP and the salt solution.

On page 3, please amend paragraph 1 to read as follows:

There is also provided ~~another~~ a method for fabricating a dehumidifying element which comprises ~~ing~~: a step of engaging a SAP to a carrier; a step of drying the carrier to which the SAP is engaged; a step of selecting a salt solution; a step of contacting the carrier with to which the SAP is engaged with the selected the salt solution in order to perform an ionic modification of the SAP; and a step of drying the carrier to which the SAP is engaged.

On page 3, please amend paragraph 7 to read as follows:

The ~~desiccant dehumidifying element~~ according to the present invention is prepared by the ionic modification of ~~includes~~ a super absorbing polymer (SAP). The desiccant can absorb more than four times larger amount of the moisture as compared with conventional desiccants such as silica-gels and zeolites. ~~so that a quantity of water having a weight several times that of the dehumidifying element can be absorbed.~~ When the relative humidity of the gas is more than 4050%, the desiccant can absorb the moisture approximately as much as its dry

~~mass. hygroscopic characteristics can be compared with a silicate desiccant dehumidifying element.~~

On page 4, please amend paragraphs 1, 2, 3, 4 and 5 to read as follows:

~~Also, a~~ A hygroscopic base salt such as lithium chloride is used ~~on~~ in the ionic modification of dehumidifying element with the SAP. It has been discovered found that the hygroscopic base salt such as lithium chloride has an excellent bonding force with the SAP by substitution ~~(it is assumed that the bonding is performed by substitution of Na⁺ by Li⁺).~~

That is, by the bonding with the SAP, the hygroscopic base salt is prevented from ~~being made volatile by air flow~~ weeping after absorbing moisture from the air. At the same time, the hygroscopic characteristics of the ~~dehumidifying element~~ SAP are improved enormously by the ionic modification with the hygroscopic basesalt.

~~Also, in case that the SAP is cross-linked, the SAP has an improved ability to absorb the base.~~

One of the most important findings in the present invention is that the improvement in the sorption capacity by the ionic modification ~~In~~ in ~~combination with the hygroscopic base such as the SAP and the lithium chloride, a concentration of~~ is strongly dependent upon the concentration of the hygroscopic basesalt in solution used at the time of fabrication influences an intensity of hygroscopic effect.

~~That is, When~~ if solution of too high concentration of the salt solution is used in

order to allow the SAP to contact— the SAP with the sufficiently large amount of hygroscopic basesalt ions, the salt solution is found not to be absorbed at all or completely into by the SAP— or is absorbed incompletely. The reason for this is considered that the swelling of the SAP is restrained in a high concentration of the salt solution and thus the amount of the absorbed solution into the SAP is reduced. Consequently, the ionic modification is not performed to a proper extent and the sorption capacity is not —improved sufficiently. ItThat is because the intensity of the hygroscopic effect of the hygroscopic base is influenced not by the amount of the base but by the concentration of the base in solution.

On the other hand, if —too low concentration of the salt solution is used, the absorbed amount of the salt ions —is not sufficiently large even though the SAP absorbs large amount of the liquid solution. As a consequence, the ionic modification thereof is not performed to a proper extent and the sorption capacity is not improved sufficiently.

The hydrogel generated by contacting the SAP with a salt solution can be changed into a proper state capable of absorbing moisture via a step of drying.

On page 5, please amend paragraph 1 to read as follows:

~~According to an experiment, the dehumidifying element absorbs humidity from gas, and is regenerated with less energy than that of the prior arts.~~

On page 5, please amend paragraph 5 to read as follows:

In case that the dehumidifying element is formed with granules, a particle diameter of the respective granules is selected in a range of 0.1 μm ~10,000 μm ;

grain fraction in a range of $1\mu\text{m} \sim 5,000\mu\text{m}$ is more preferable, and grain fraction in a range of $20\mu\text{m} \sim 1,000\mu\text{m}$ is most preferable.

On page 7, please amend paragraphs 1, 2 and 3 to read as follows:

Then, the hygroscopic characteristics of the element fabricated in the 3-dimension shape can be realized by selecting the salt solution. Regardless of the realization form that the SAP takes a granular form or the SAP is included in the carrier, by drying the SAP at first, the SAP can absorb the salt solution much more. According to this, the SAP can be contacted to the hygroscopic ~~base~~salt. The SAP is provided with the hygroscopic ~~base~~salt by contacting the salt solution with the SAP. ~~The element composed of the carrier including the hydrogel generated by contacting the granules with the salt solution or SAP is dried, thereby being converted into a state to~~ capable of absorbing humidity~~moisture~~.

~~When~~If the granules of the SAP is engaged to each other and forms -large agglomeration~~realized as loose granules, it is preferable that the lump~~agglomeration of the SAP is crushed to pieces and the granules are classified before contacting with the salt solution. According to this, uniform characteristics of the element can be realized. Likewise, if the SAP is engaged to each other and forms large agglomeration ~~coagulated after the step of final drying, it is also desirable that the~~ the agglomeration of the modified SAP is granules are crushed to pieces and the granules are classified, ~~thereby newly classifying finally in any case.~~

Another method for fabricating a dehumidifying element with an SAP

desiccant modified ionically is making contact the carrier including the SAP with a salt solution.

If the carrier including the SAP is contacted to the salt solution, dried slowly, and the drying temperature is ~~smoothly~~ increased slowly, an adequate smooth-regeneration is possible and thus the salt solution is excellently absorbed by the SAP. On the contrary, it has been observed that the salt solution is extracted from the surface of the carrier instead of being absorbed was not perfectly absorbed into the SAP when the regeneration temperature is increased fast to carrier was to be dried at the highest regeneration temperature level.

On page 8, please amend paragraphs 1 and 2 to read as follows:

The m~~Most~~ important in the preparation of the desiccant is to select the concentration of the a salt solution Especially, the salt solution used to fabricate the dehumidifying element is selected including between 5-15wt% of hygroscopic base concentration. In this case of using the salt solution of the concentration between 5-15wt%, thea sorption capacity an intensity of the modified SAP can be optimized between the restrictions in the liquid sorption capacity and in the highest concentration of the salt solution. of the SAP modified with the hygroscopic base in a range among too high an ion concentration and limitation variables of super absorption can be attained at an optimum state. That is, the hygroscopic base salt of a the maximum amount can be contacted to the SAP by making selecting the base salt concentration as between 5-15wt%, or more preferably as 10wt% . The reason is that because the salt solution cannot beis not

~~absorbed perfectly properly into~~by the SAP in case of using too high concentrated ~~ion~~ solution due to the inherent characteristics of the SAP restraining itself from swelling in high ion density, and that the salt ~~because base-~~ions are not perfectly absorbed sufficiently into the SAP in case of using too low concentrated solution due to the limitation on the liquid sorption capacity of the ~~when the base concentration is low due to too high an ion concentration, and because an absorption power of the SAP for liquid is exceeded~~SAP.

~~When~~If the carrier including the SAP of a granular form is contacted with the salt solution, and ~~if the the~~ absorption ~~capacity~~power for the salt solution ~~of the~~ SAP is ~~very high~~too strong, the granule particles tend to be ~~agglomerated~~ coagulated to form a large lump after a step of drying. Therefore, it is ~~prefera~~ed ~~bly~~ that, the carrier is contacted ~~with~~ the salt solution in several ~~steps~~stages according to the fabrication steps of the carrier. At this time, at each ~~stage~~step, the carrier is partly contacted ~~by a part of~~ with the salt solution, and the contact is realized ~~performed by~~ drizzling, sprinkling, spraying, etc.

On page 11, please amend paragraphs 3, 4, 5 and 6 to read as follows:

~~If the SAP granules 1 are modified at an outside of the porous carrier formed of fiber composite or web bunch, the granules need to be classified to have uniform size distribution and equal granule characteristics on the basis of very broad size distribution. In this case, a sieve classifier is preferably used.~~

In order to maintain the residual humidity of content of the moisture in the SAP minutely to a minimum extent and thus to allow the SAP to absorb the salt

solution as much as possible in contacting with the salt solution afterward~~later, it is necessary that the granules or fibers be~~ dried completely before contacting with the salt solution~~to absorb the SAP granules or the SAP fibers. In this case~~ For this purpose, a vacuum drier is ~~can be used preferably. The vacuum drier applie~~ exerts a very small thermal load~~influence on~~ of heat to the granules ~~very minutely at the time of drying, thereby preventing a stability depreciation by temperature change through a long term view~~considering a temperature safety of maximum long term life of the SAP.~~~~

Then, the dried SAP granules are modified ionically by~~with~~ the salt solution, and can be variously processed. For example, the SAP granules can be provided in the salt solution or the solution can be added to the granules.

After the ionic modification, the hydrogel generated from the SAP granules is dried, thereby regenerating ~~and at the same time, the granules are regenerated.~~ The hydrogel can be layered on a plate as thin as possible thereby restricting the formation of the lump in the step of drying~~dried by being applied as a planar layer with a maximum thickness of 1cm on a plate. According to this, a lump formation at the time of drying can be prevented. However, In case of lump formation, it is necessary to crush the lump. It is suitable to use since solidification always follows, a proper crushing is necessary. To this end, an impact crusher or a breaker~~ for this end. is suitable.

On page 12, please amend paragraphs 1, 2, 3 and 4 to read as follows:

~~A new classification is performed in order to maintain the SAP granules~~

~~generated from the gel, crushed, and modified to provide the hygroscopic base with a uniform size.~~

~~When~~If the SAP granules or the SAP fibers are located within the carrier or thereon before the modification using the salt solution is started, in order to perform an ionic modification of the SAP, firstly it is required for the entire carrier including the SAP to be is dried, thereby reducing the amount of the water contained therein to a minimum extent~~by considering the heat load transmitting ability of the SAP and the carrier in order to decrease water containing amount to the minimum. And the selection of The the salt solution is carried out selected by a method similar to the aforementioned methods.~~

When the porous carrier 2 including the SAPs 1 and 3 is contacted with the salt solution, it would be better to contact in multistage plural times ~~between the porous carrier 2 and the salt solution should be considered whether or not the modification is performed in plural stages.~~ The reason is that the granular particles 1 can be engaged and solidified-agglomerated into a lump in or on the porous carrier 2, or thereon ~~Although it is possible to crush a lump formed through an ionic modification of the SAP itself, it would be impossible to crush a lump formed through an ionic modification of a SAP engaged into a carrier. Therefore, it is important to restrict the generation of the lump in a step of contacting the carrier containing the SAP with the salt solution~~like the modification of the granules at the time of absorbing the salt solution too strongly. When the~~The solution can be prudently~~ is contacted with the carrier including the SAP in multiple stages by, ~~procedures such as drizzling, sprinkling, or spraying can be~~

~~performed. The procedures are very important since the solidification is not removed even by the crushing due to the carrier material.~~

Finally, the carrier 2 including the SAP is dried slowly, ~~that is, within one or two days, and at the same time wherein;~~ the drying temperature is gradually increased ~~through~~during the drying ~~process~~term until it rises almost to the maximum regeneration temperature.

On page 13, please amend paragraphs 1 and 2 to read as follows:

This step of slowly drying of the carrier 2 including the SAP ~~performed by~~ slowly increasing the temperature causes to maintains the structure of the modified SAP. That is, the SAP is not decomposed. The drying method includes a freeze drying, a microwave drying, a normal drying, or a combination drying therebetween.

A method for fabricating the dehumidifying element, which is formed to increase the contact area with air, with modified SAP granules or the modified SAP fiber~~If the porous carrier is structured and/or arranged by a method that a dehumidifying body is formed, the SAP granules or the SAP fiber inserted in the porous carrier or applied thereon can be properly performed~~modified. The structured of the porous carrier, as shown in Figures 2 and 3, includes a trapezoid wave shape as a structured sheet, and at the same time, a sheet of a corrugated reed shape has a ripple of 2.5~7mm, an interval length (a), a ripple of 1 ~5mm, and a wave height (b).

On page 14, please amend paragraphs 3 to read as follows:

Regardless of the point in time of the ionic modification, that is, regardless of whether the SPA granules or the SAP fiber is contacted to the hygroscopic base or not, whether the SPA granules or the SAP fiber is contacted to the hygroscopic base with a location in the porous carrier or thereon or not (Figure 1), or whether the modification is started after the porous carrier passes several transformation steps or not (Figures 3, 4B, and 4C), lithium chloride adjacent on the surface of the SAP permits not only water to be added but also water to be guided inside of the superabsorber.